NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-215

THIRD BODY CALIBRATION LOGIC FOR THE EARTH-CENTERED CONIC ABORT SUBPROCESSOR OF THE RETURN-TO-EARTH ABORT PROCESSOR

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
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PROJECT APOLLO

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SUMMARY AND INTRODUCTION

The enclosed flow chart of the subroutine VUP2 constitutes the conic three-body calibration logic for the earth-centered conic subprocessor, reference 1. This subroutine is to be included in the block labeled "Store solutions" on page 17 of reference 1. The logic presented here replaces that which was defined in reference 2. Black bars in the margin indicate the area of change.

The logic specified in reference 1 is intended for the near-earth maneuvers. The enclosed logic extends the region of acceptable analytic solutions so that the processor can be used for maneuvers where the lunar perturbations on the conic solution are appreciable. The original model, reference 3, was developed for the purpose of improving the accuracy of the fuel requirements (ΔV) computed from a conic solution. The enclosed logic extends that in reference 3 and improves the accuracy of that in reference 2.

DISCUSSION OF THE FLOW CHART

On the fourth page of the flow chart is a test comparing the magnitude of sin η (where η is the true anomaly) against the tolerance, TRUBLE. The purpose of the test is to avoid computational difficulties in the region where true anamoly is nearly 180°. As η approaches 180° the last two terms, named TERM, in the partial derivative $\frac{\delta T}{\delta V}$ should vanish. Thus, whenever $|\sin \eta|$ is less than the tolerance, TERM is not computed but set equal to zero. The value of TRUBLE is a function of the precision of the computations and thus should be adjusted for the particular computer. An initial value determined for single precision of the IBM 7094 is 0.1°.

The subroutine is called as follows.

Subroutine VUP2 ($\overline{RB}$, $\overline{VB}$, Tar, βr, $\overline{RMOON}$, T_{Abort}, $\overline{VBC}$)

where

$\overline{RB}$ is the position vector at abort

$\overline{VB}$ is the conic post abort velocity vector

Tar is the flight time from abort to reentry

βr is the path angle at reentry

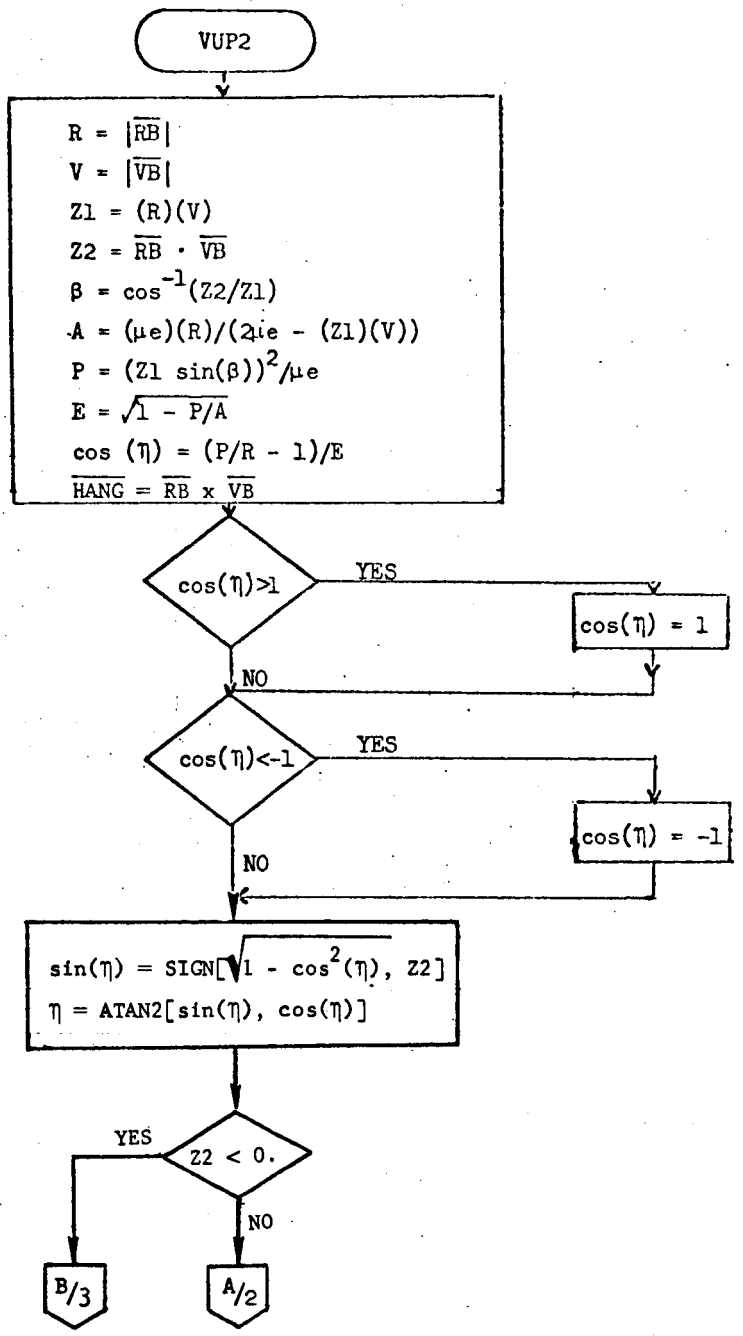
$\overline{RMOON}$ is the position vector of the moon at abort time

T_{Abort} is the time of abort

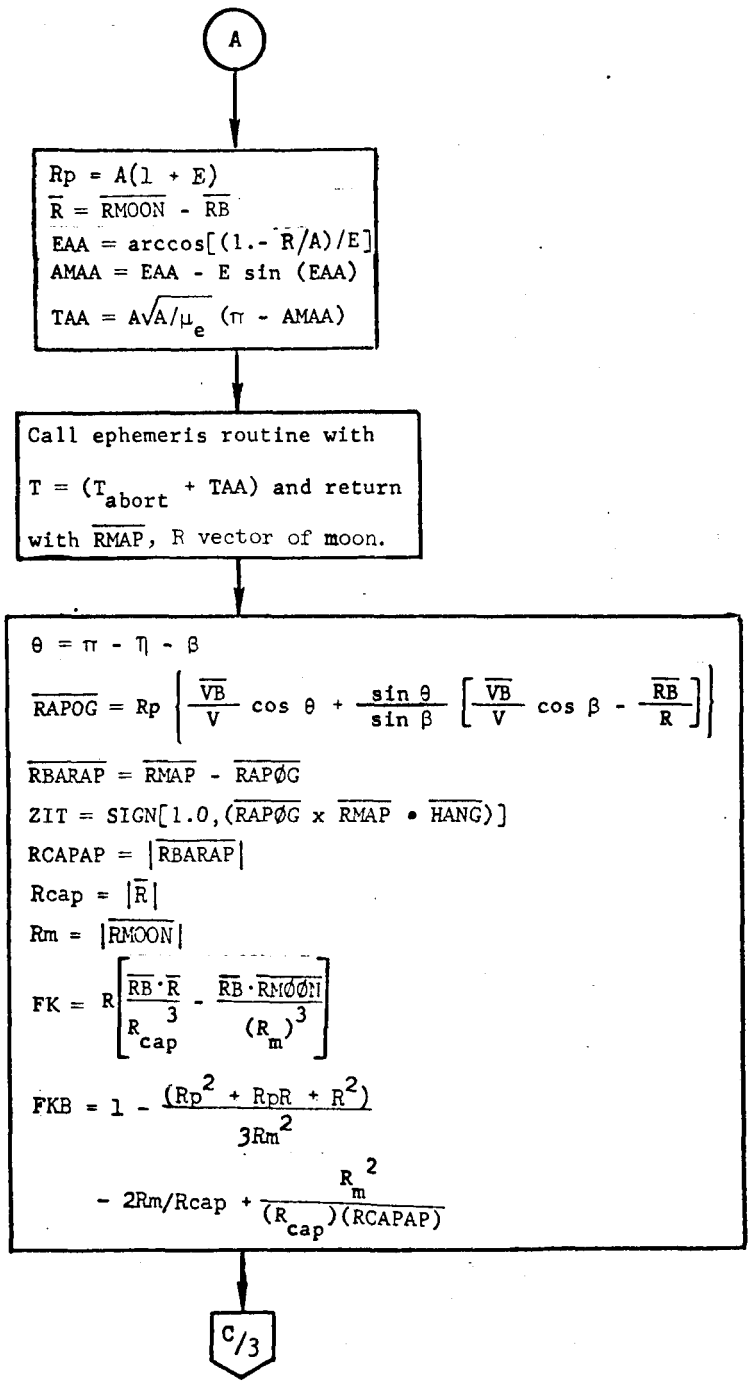
$\overline{VBC}$ is the postabort velocity calibrated to include the lunar third body effect

Return with $\overline{VBC}$.

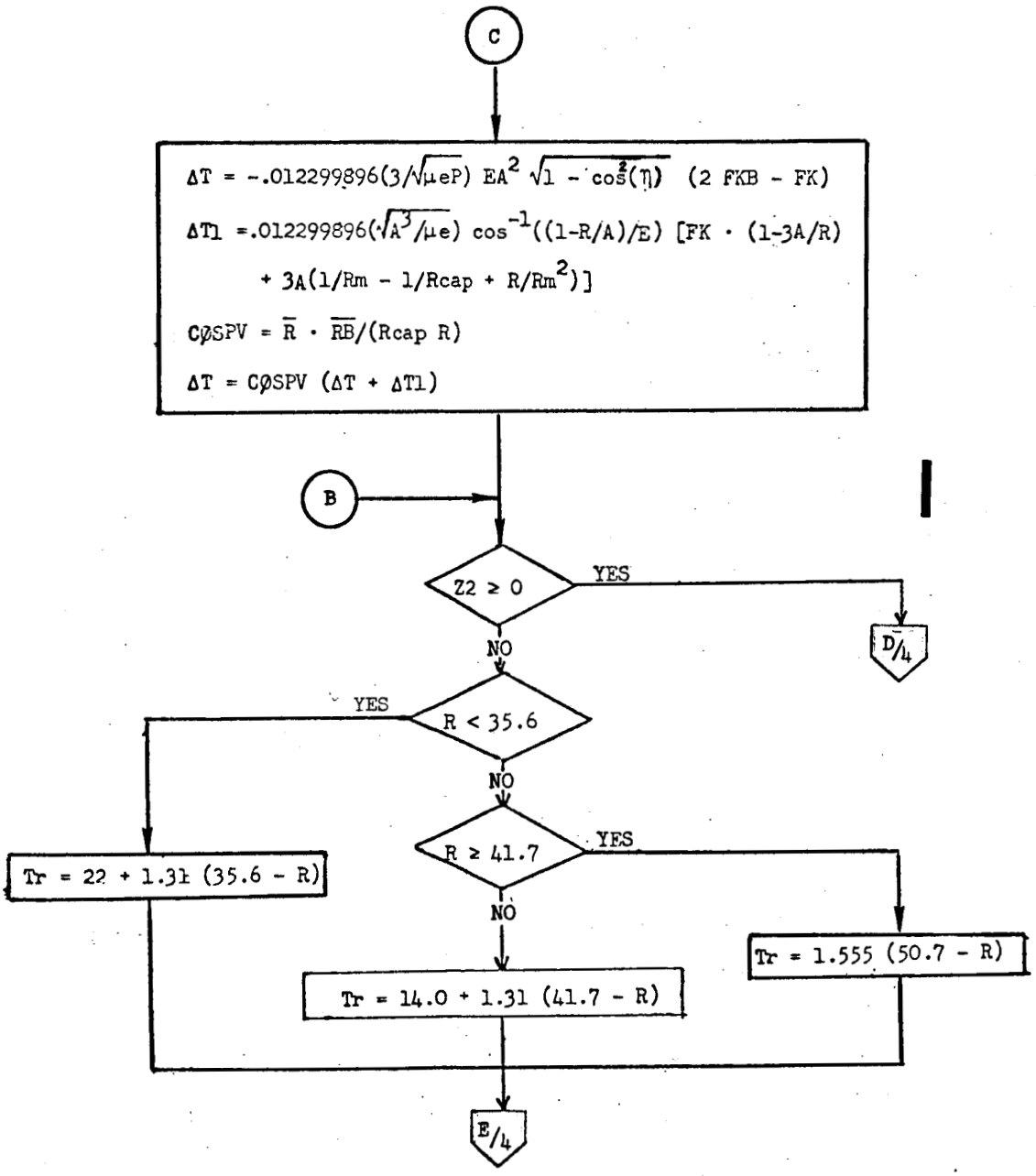
Symbols not defined here or in the flow chart are defined in reference 1.



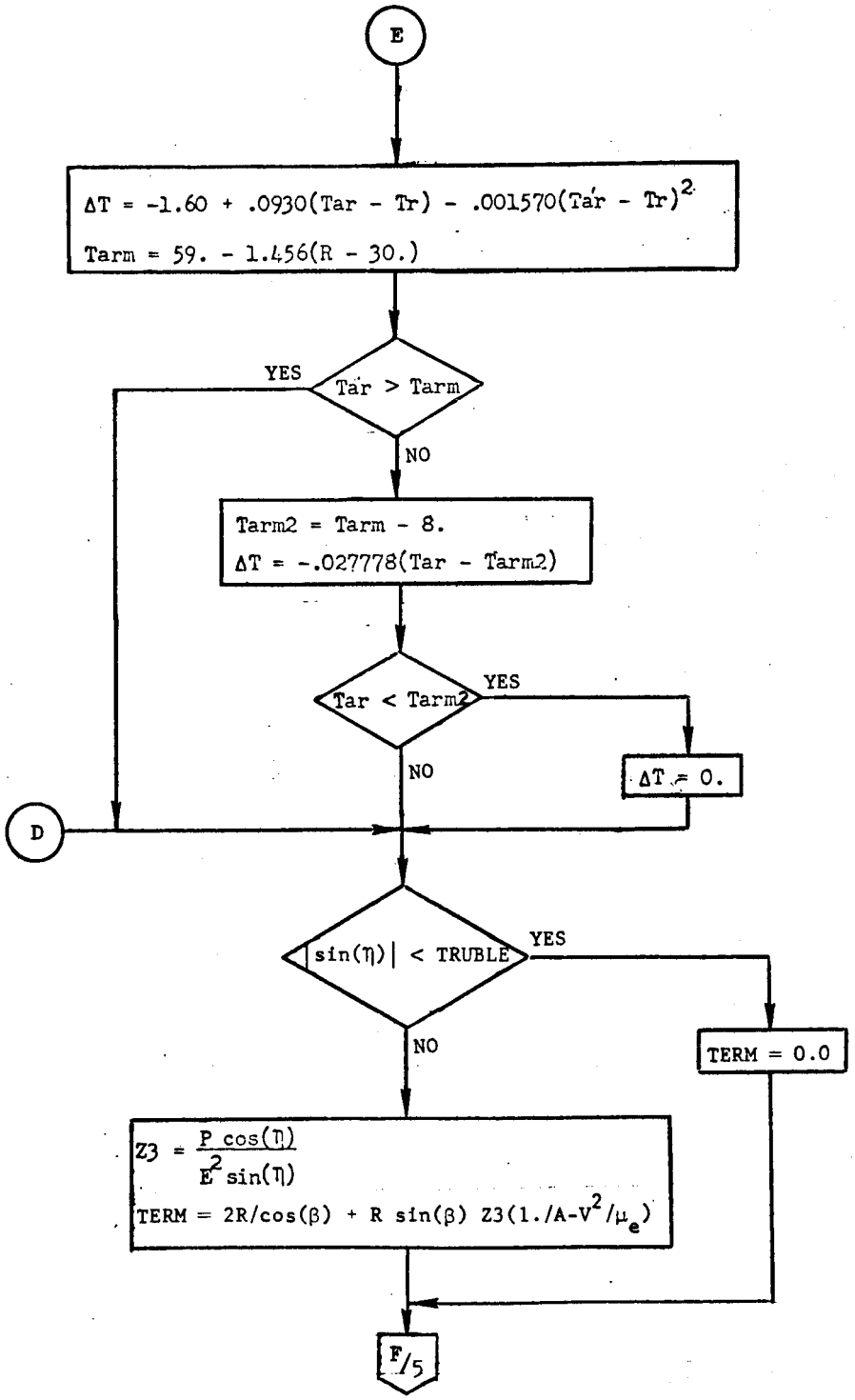
Flow chart 1.-Subroutine VUP2.



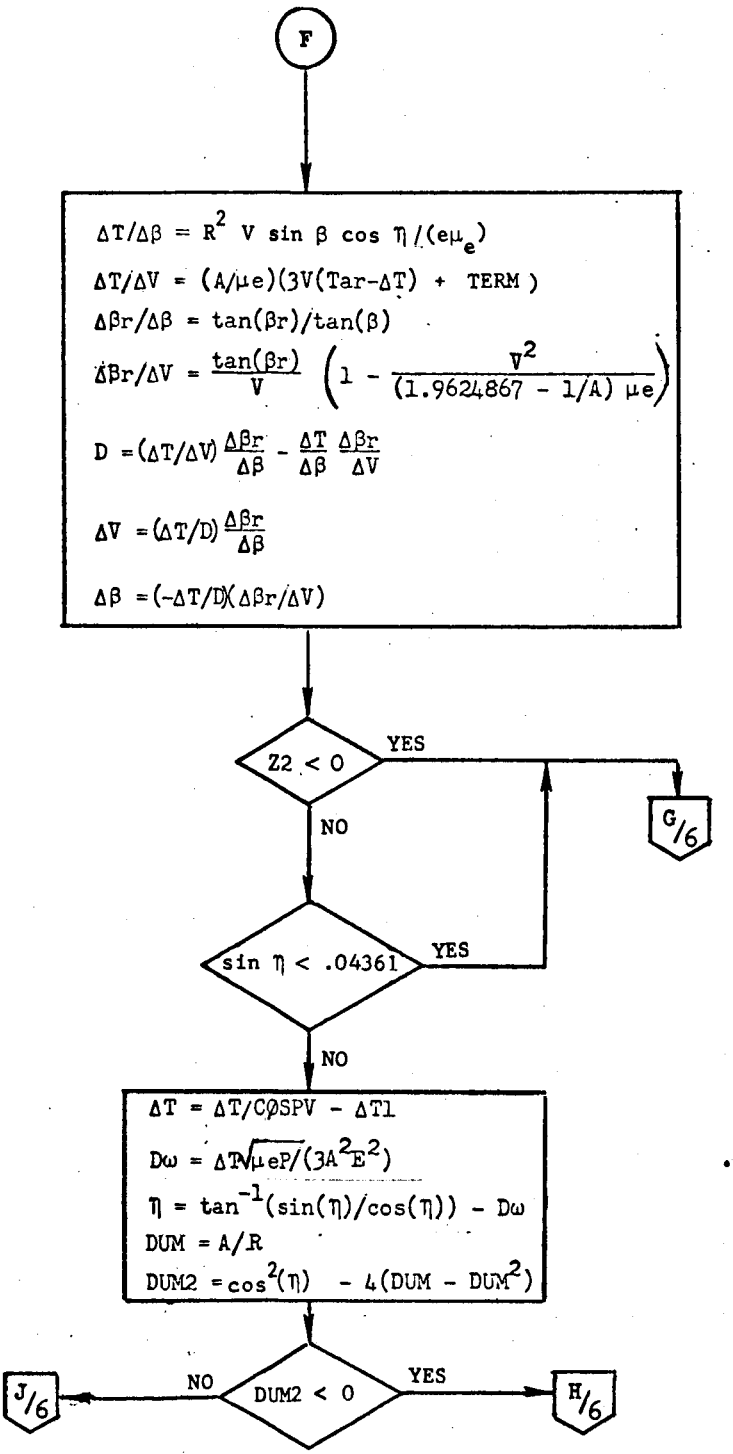
Flow chart 1.-Subroutine VUP2 - Continued.



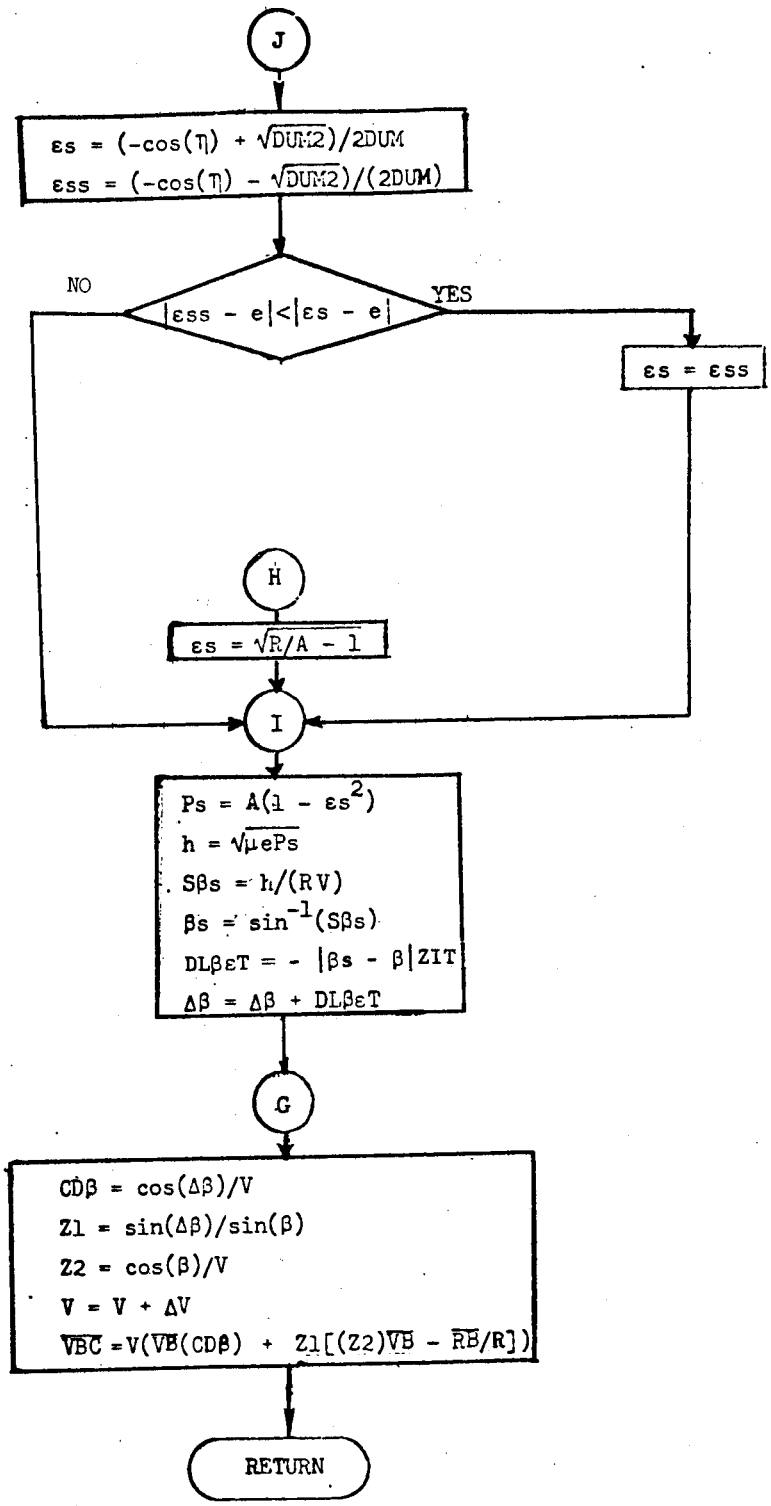
Flow chart 1.-Subroutine VUP2 - Continued.



Flow chart 1.-Subroutine VUP2 - Continued.



Flow chart 1.-Subroutine VUP2 - Continued.



Flow chart 1.-Subroutine VUP2 - Concluded.

REFERENCES

1. Lee, W. R.: AS-503A Requirements for the RTCC: Return-To-Earth Conic Subprocessor - Revision 1. MSC IN 67-FM-56, December 12, 1967.

2. Frank, M. P.: RTCC Requirements for the Return-To-Earth Processor. MSC Memorandum 68-FM51-34, February 2, 1968.

3. Suttles, T. E.: Use of VRMANT Techniques to Reduce Errors in Conic Fuel Predictions. TRW IOC No. 3412.3-39, June 6, 1967.